

REMARKS

Claims 1, 3, 4, 6, 7, 9 and 11-18 are pending. Claims 1, 3, 4, 6, 7, 9 and 11-18 stand rejected. Claims 1, 4, 7, 9, 11, 15 and 17 have been amended. In view of the amendments to the claims and the remarks below, Applicants respectfully request that the rejections be withdrawn and the claims be allowed.

Claims 1, 4, 7, 9, 11 and 15 stand rejected under 35 U.S.C. § 112, first paragraph, as including subject matter not adequately disclosed in the specification. The rejection is respectfully traversed.

Claims 1 and 4 recite that at a first one of said plurality of storage controllers, a host command is received and that the host command is stored. Claims 1 and 4 also recite that, at a later time, the stored host command is erased. Support for this claim language is provided in paragraph [0035] of the specification. "In this example, host₁ 115 sends the request to RAID controller 2130 via network communication fabric 110.... RAID controller 2130 stores the write command in its cache 139 and forwards the write request to RAID controller 1120 for storage element 127 and storage element 128. When RAID controller 1120 has completed the write request, it sends a write complete status back to RAID controller 2130. RAID controller 2130 then forwards the write complete status back to host₁ 115 and deletes the original stored command."

Claims 7, 9, 11 and 15 recite the receiving and storing of a host command and the reporting of an execution status of the host command by a single storage controller "even when the host command is executed by others of the plurality of storage controllers." Support for this claim language is also provided in paragraph [0035] of the specification. "In this example, host₁ 115 sends the request to RAID controller 2130 via network communication fabric 110.... RAID controller 2130 stores the write command in its cache 139 and forwards the write request to RAID controller 1120 for storage element 127 and storage element 128. When RAID controller 1120 has completed the write request, it sends a write complete status back to RAID controller 2130. RAID controller 2130 then forwards the write complete status back to host₁ 115 and deletes the original stored command."

Because the subject matter of claims 1, 4, 7, 9, 11 and 15 is disclosed in the original application, as explained above, Applicants respectfully request that the rejection of claims 1, 4, 7, 9, 11 and 15 over 35 U.S.C. § 112, first paragraph, be withdrawn and the claims be allowed.

Claims 1, 3, 4, 6, 7 and 9 stand rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent Application Publication No. 2002/0026540 to Smyers ("Smyers"). The rejection is respectfully traversed.

Claim 1 relates to a "method for processing a host command in a storage system including a plurality of storage elements coupled to a plurality of storage controllers." The method includes "receiving a host command directed to a volume of said storage system from a host," the host command received "at a first one of said plurality of storage controllers." A target storage controller is determined for the host command, and, "if said target storage controller is not said first one of said plurality of storage controllers, forwarding the host command to said target storage controller." The target storage controller executes the command and then forwards "to said first one of said plurality of storage controllers ... an execution status indicating completion of said host command." The first one of said plurality of storage controllers receives "said execution status" and forwards "said execution status to said host." As explained below, Smyers fails to disclose each element and limitation of claim 1.

Smyers discloses a system where a controller receives a record instruction and then sends the record instruction to a selected audio/video hard disk drive ("AVHDD"). Smyers, ¶¶ [0031], [0032]. Once an AVHDD is selected to record content and that AVHDD is ready to record, control of recording content is shifted to the selected AVHDD. Smyers, ¶ [0033]. "The recording AVHDD then begins recording the stream of data from the source [or host] device. If the recording AVHDD runs out of available storage space while the source device is still transmitting the stream of data, the recording AVHDD, will locate the next available AVHDD within the network and forward the record command to that AVHDD." *Id.* "Once the next available AVHDD begins recording the stream of data, it ... inform[s] the prior recording AVHDD that it is successfully recording the stream of data." Smyers, ¶ [0035].

Although Smyers discloses the sending of communications between prior and currently recording AVHDDs, nowhere does Smyers disclose that a specific AVHDD or controller forwards “an execution status to said host,” where the execution status indicates “completion of said host command,” as recited in claim 1. The Office Action states that a “recording status is inherently forwarded to the [host] computer to acknowledge [to] the user the recording status.” The Office Action is silent regarding which controller inherently acknowledges the recording status and what the recording status indicates. Similarly, Smyers does not indicate which device, if any, in the controller/AVHDD system would inherently send an execution status to a host indicating completion of the host command. Conceivably, either the Smyers controller or one of the AVHDDs could send an execution status, if it is sent at all. Furthermore, the inherently forwarded recording status does not indicate completion of the received command, but only initialization of the received command. “Once the next available AVHDD begins recording the stream of data, it ... inform[s] the prior recording AVHDD that it is successfully recording the stream of data.” Smyers, ¶ [0035]. Claim 1, however, recites that the “first one of said plurality of storage controllers,” the controller that received “a host command ... from a host,” is the device that forwards the execution status, and that the execution status indicates the completion of the host command.

Additionally, claim 1 recites that a copy of the received host command is stored at the first one of said plurality of storage controllers “until the host command has been executed and the execution of the host command has been reported to the host.” After the command is executed and the execution status is forwarded to the host, the first one of said plurality of storage controllers erases “the stored copy of the host command.” Smyers does not disclose the storage of a host command on a first receiving controller until the host command has been executed to completion.

For at least these reasons, Smyers fails to anticipate claim 1, and claim 1 is allowable over Smyers. Claim 3, which depends from claim 1, is also allowable over Smyers for at least the same reasons that claim 1 was allowable.

Claim 4 also relates to a “method for processing a host command in a storage system including a plurality of storage elements coupled to a plurality of storage controllers.” In claim 4,

“a first one of said plurality of storage controllers” receives a host command. The first one of said plurality of storage controllers stores “the host command until the host command has been executed and the execution of the host command has been reported to the host.” and determines “a plurality of target storage controllers” to send component commands to, “the component command for a particular one of said plurality of storage controllers corresponding to at least a portion of the host command and relating to the logical volume associated with the particular target controller.” Once each target storage controller executes its component command, the at least first one of said plurality of storage controllers receives an “execution status from each one of said plurality of target storage controllers,” the received execution statuses “indicating completion of said component command.” The first one of said plurality of storage controllers determines “an aggregate host command execution status from said received execution status” and forwards “said aggregate host command execution status to said host.” The stored host command is erased by the first one of said plurality of storage controllers. Smyers fails to disclose each of these elements and limitations.

Smyers does not disclose the “determining [of] an aggregate host command execution status from said received execution status,” as recited in claim 4. The Examiner asserts that “Smyers discloses forwarding an recording status associated with the recording command to the prior recording AVHDD in paragraph 34-35, wherein the AVHDD 32 forwards the recording status to the AVHDD 34 after that, the AVHDD 34 forwards the final aggregated recording status to the AVHDD 36.” Office Action, p. 7. The Examiner further states that “the recording indication [is] aggregated since the AVHDDs are in cascaded format, wherein the recording indications are passed and updated.” Office Action, p. 21. Applicants respectfully disagree with this interpretation of Smyers. Smyers teaches that “[o]nce the next available AVHDD begins recording the stream of data, it ... inform[s] the prior recording AVHDD that it is successfully recording the stream of data.” Smyers, ¶ [0035]. However, there is no indication in Smyers that the prior recording AVHDD aggregates the forwarded indication with any other recording indication and then itself forwards the aggregate to another AVHDD, as asserted in the Office Action. Smyers teaches nothing about aggregating multiple execution statuses. Also, as discussed above, Smyers fails to disclose that the “first one of said plurality of storage controllers” forwards any type of execution

status indicating completion of the host command to the host, regardless of whether the execution status is an aggregation of statuses or a status from a single target storage controller. The recording indication forwarded by Smyers indicates an initialization of recording, not a completion.

Furthermore, as indicated above, Smyers fails to disclose that the first one of said plurality of storage controllers stores the host command upon receipt of the host command, and then later erases the stored command after the aggregate host command execution status has been forwarded to the host.

For at least these reasons, Smyers fails to anticipate claim 4, and claim 4 is allowable over Smyers. Claim 6, which depends from claim 4, is also allowable for at least the same reasons that claim 4 is allowable.

Claims 7 and 9 both relate to a storage system that includes a plurality of storage controllers. The “plurality of storage controllers further comprise means for processing a host command received on any host port targeted to” any one or more of a “plurality of storage elements, the host command being received and stored by a single storage controller of the plurality of storage controllers and an execution status indicating completion of the host command being reported to a host by the single storage controller even when the host command is executed by others of the plurality of storage controllers.” Smyers fails to disclose at least these elements and limitations of claims 7 and 9.

As explained above, Smyers does not disclose a single controller that receives and stores a host command and then reports the execution status indicating completion of the host command to the host. Smyers fails to disclose which, if any, device reports an execution status to the host. Smyers fails to disclose an execution status that indicates completion of the host command. And Smyers does not disclose the storing of a host command on a controller “even when the host command is executed by others of the plurality of storage controllers.” For at least these reasons, Smyers fails to render claims 7 and 9 unpatentable.

Thus, because Smyers fails to disclose each element and limitation of claims 1, 3, 4, 6, 7 and 9, these claims are allowable over Smyers. Applicants respectfully request the rejection be withdrawn and the claims be allowed.

Claims 11-16 stand rejected under 35 U.S.C. § 103(a) as being obvious over Smyers in view of U.S. Patent Application Publication No. 2001/0002480 to Dekoning et al. ("Dekoning"). The rejection is respectfully traversed.

Claims 11 and 15 relate to scalable storage controllers that include a plurality of modules. Each module includes a processing element. Claim 11 recites that "the processing element of each of said modules is configured to search mappings between storage volumes and storage devices and to receive and store a host command and report the execution status of the host command to a host even when the host command is executed by others of the plurality of modules, the execution status indicating completion of the host command." Claim 15 recites that "the processing element of each of said modules is configured to process a host command for accessing a virtual volume by causing each module associated with said virtual volume to access its respective storage device, to search mappings between virtual volumes and logical volumes and to store the host command and report the execution status of the host command to a host even when the host command is executed by others of the plurality of modules, the execution status indicating completion of the host command." Neither Smyers nor Dekoning, either individually or combined, teach or suggest at least these elements and limitations of claims 11 and 15.

As discussed above, Smyers fails to teach or suggest a module with a processing element configured "to receive and store a host command and report the execution status of the host command to a host even when the host command is executed by others of the plurality of modules, the execution status indicating completion of the host command." Smyers does not teach that the receiving module report the execution status of the host command to a host, wherein the execution status indicates completion of the host command. Additionally, as admitted in the Office Action, Smyers does not teach that each module include a cache memory. Office Action, p. 12. For at least

these reasons, Smyers does not teach or suggest each of the elements and limitations of claims 11 and 15.

Dekoning also fails to remedy the inadequacies of Smyers. Dekoning is relied upon to show the existence of a cache memory in each module connected to a primary interconnect. Office Action, p. 12. However, Applicants respectfully disagree that Dekoning shows the existence of a cache memory within each module. Figure 4 of Dekoning, referenced in the Office Action, shows a cache memory in two specific caching controller devices. However, a cache memory is not shown within the multiple data storage element controllers. In fact, the Dekoning invention has no need “for duplicative local cache memory on each of the plurality of storage controllers” because of the existence of one or more central caching controllers. Dekoning, Abstract. In other words, Dekoning does not teach, but instead teaches away from the inclusion of a cache memory in each module of the scalable storage controllers recited by claims 11 and 15.

Furthermore, for the same reasons, Dekoning does not teach that each module includes a processing element configured to “store the host command and report the execution status of the host command to a host even when the host command is executed by others of the plurality of modules, the execution status indicating completion of the host command.” In Dekoning, only the caching controller stores the host command, not the data storage element controllers. Additionally, Dekoning fails to remedy the inadequacies of Smyers relating to the reporting of an execution status, wherein the status indicates a completion of the host command.

For at least these reasons, the combination of Smyers and Dekoning fails to render claims 11 and 15 unpatentable. Claims 11 and 15 are allowable. Claims 12-14 depend from claim 11, and are thus allowable for at least the same reasons claim 11 is allowable. Claim 16 depends from claim 15 and is allowable for at least the same reasons that claim 15 is allowable. Applicants respectfully request the rejection be withdrawn and the claims allowed.

Claims 17 and 18 stand rejected under 35 U.S.C. § 103(a) as being obvious over Smyers in view of U.S. Patent No. 6,850,938 to Sadjadi (“Sadjadi”). The rejection is respectfully traversed.

Claim 17 relates to a method of conflict detection in “a storage controller comprising a plurality of modules each capable of receiving host commands.” The method includes “receiving, at a first module, a first access request, storing the first access request at the first module until the first access request has been completed, receiving, at a second module, a second access request, [and] storing the second access request at the second module until the second access request has been completed.” Once an access request is executed by either of the first or second modules, the executing module forwards “an execution status to a host that sent the access request, the execution status indicating the completion of the access request.” Neither Smyers nor Sadjadi teach or suggest each of the elements and limitations recited by claim 17.

As explained above, Smyers fails to teach or suggest a module that receives and stores an access request and also forwards an execution status to the requesting host. Sadjadi also fails to remedy the inadequacies of Smyers.

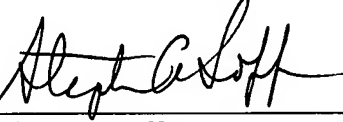
Sadjadi teaches a method of conflict detection and resolution, but still does not teach all of the elements and limitations recited in claim 17. Specifically, Sadjadi fails to teach or suggest that a receiving module stores an access request. Additionally, Sadjadi does not teach or suggest the forwarding of an execution status to the requesting host, the execution status indicating completion of the access request. For at least these reasons, Sadjadi fails to render claim 17 unpatentable.

Because neither Smyers nor Sadjadi, individually or combined, teaches or suggests at least these elements and limitations of claim 17, claim 17 is allowable over the combination of Smyers and Sadjadi. Claim 18, which depends from claim 17, is also allowable for at least the same reasons claim 17 was allowable. Applicants respectfully request the rejection be withdrawn and the claims be allowed.

In view of the above amendment, Applicants believe the pending application is in condition for allowance.

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